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The Report of an Examination of Both Temporal Bones from a Hundred and Twenty Individuals in Reference to the Question of Symmetry in Health and Disease.

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PREFATORY NOTE.

THE examination was undertaken to ascertain facts as to the symmetry of the temporal bones, a subject on which little reference is made in otological and anatomical literature, but which has, I venture to think, important bearings on the causation, diagnosis and treatment of disease.

The following is a list of the sex and age of the individuals:

1. M. $\frac{9}{12}$.
2. F. $1\frac{7}{12}$.
3. ?. $1\frac{9}{12}$.
4. M. 2.
5. F. 2.
6. ?. $2\frac{2}{12}$.
7. M. $3\frac{3}{12}$.
8. F. 6.
9. M. 9.
10. M. 11.
11. F. 16.
12. M. 20.
13. F. 21.
14. F. 22.
15. M. 24.
16. M. 24.
17. F. 25.
18. M. 28.
19. M. 28.
20. F. 28.
21. F. 28.
22. F. 29.
23. M. 30.
24. M. 30.
25. M. 30.
26. F. 30.
27. M. 33.
28. M. 33.
29. M. 33.
30. F. 33.
31. M. 34.
32. M. 35.
33. F. 35.
34. M. 36.
35. F. 36.
36. F. 36.
37. M. 37.
38. M. 37.
39. F. 37.
40. M. 38.
41. M. 38.
42. F. 38.
43. F. 38.
44. M. 39.
45. M. 39.
46. M. 39.
47. M. 39.
48. M. 39.
49. F. 41.
50. M. 42.
51. F. 42.
52. M. 43.
53. F. 43.
54. M. 44.
55. M. 45.
56. M. 45.
57. M. 45.
58. M. 47.
59. M. 48.
60. M. 48.
61. F. 48.
62. F. 48.
63. M. 49.
64. M. 49.
65. M. 49.
66. F. 49.
67. M. 50.
68. F. 50.
69. F. 50.
70. M. 51.
71. M. 51.
72. M. 51.
73. M. 52.
74. M. 53.
75. F. 53.
76. F. 54.
77. F. 54.
78. F. 55.
79. F. 55.
80. F. 55.

81. M. 56.	*91.* M. 60.	*101.* M. 64.	*111.* M. 72.
82. F. 56.	*92.* M. 60.	*102.* M. 64.	*112.* M. 72.
83. M. 57.	*93.* M. 61.	*103.* F. 64.	*113.* F. 72.
84. F. 57.	*94.* M. 61.	*104.* F. 64.	*114.* F. 73.
85. M. 58.	*95.* F. 61.	*105.* M. 66.	*115.* F. 76.
86. M. 58.	*96.* F. 61.	*106.* F. 66.	*116.* F. 77.
87. M. 59.	*97.* F. 61.	*107.* M. 67.	*117.* F. 81.
88. M. 59.	*98.* F. 62.	*108.* M. 68.	*118.* M. 82.
89. M. 59.	*99.* F. 62.	*109.* M. 68.	*119.* F. 86.
90. M. 59.	*100.* F. 63.	*110.* M. 71.	*120.* F. 89.

I regret the deficiency in the number of infants and children, but this part of my collection is still in its infancy. The sex is known in all except in two, one aged one year and nine months and the other two years and two months. There are sixty-eight males and fifty females. The specimens are arranged according to age, and if there are several of the same age, the males are placed before the females. Each bone is separately placed and numbered, the right immediately preceding its corresponding left bone; the odd numbers therefore represent the right and the even numbers the left bones.

In referring to specimens the following method is used: $\frac{\text{Number of the right bone}}{\text{Number of the left bone}}$, sex, age; for example, $\frac{71}{72}$ F. 36.

The bones are, in the main, vertically sectioned through the outer antral wall, mastoid process, middle-ear tract and labyrinth. Sections in other directions have been made when thought necessary. Further sections will be made immediately if any members of the Congress express such a wish.

The report is considered under two main headings:

A. In Health.

B. In Disease.

A. IN HEALTH.

This part is considered under two headings: (1) The Exterior; (2) the Interior.

1. The Exterior.

(i) The External Surface.

Symmetry is the rule in markings, shape and size.

(*a*) In one specimen *the temporal ridge* behind the antrum is more prominent on the right side, $\frac{1}{1}\frac{6}{6}\frac{1}{2}$ M. 56.

(*b*) In two sets the *posterior zygomatic line* on the right side above the antrum has an inclination downwards and backwards and an overhanging appearance associated with a markedly high-lying antrum, conditions which are not seen on the left side and in which the antrum is not high lying, $\frac{1}{1}\frac{4}{4}\frac{7}{8}$ M. 53 and in $\frac{1}{1}\frac{8}{8}\frac{6}{0}$ M. 61.

(*c*) *A specially large foramen*, evidently from a vessel, is present immediately above the meatal spine, leading to the coarse cells in the outer antral wall on both sides in $\frac{1}{1}\frac{6}{6}\frac{5}{6}$ M. 57.

(*d*) *Perforations in the cortex of the supra-meatal triangle* exposing the cells lining the outer antral wall are present, on the right side only in $\frac{7}{8}\frac{9}{0}$ M. 38 and on the left side only in $\frac{3}{3}\frac{3}{4}$ F. 25. There is no evidence of disease in either.

(*e*) *The supra-meatal spine* presents many variations and one side is occasionally larger than the other, but symmetry is the rule.

(*f*) The remains of the *masto-squamosal suture* when present are usually symmetrical, but in three sets one side is more marked than in the other; one on the right side, $\frac{207}{208}$ F. 64, and two on the left, $\frac{29}{30}$ M. 24, $\frac{211}{212}$ F. 66.

(*g*) There is very little *variation in the size and shape of the mastoid process*; the left is slightly larger and more pronounced in $\frac{7}{8}$ M. 2 and the right in $\frac{185}{186}$ M. 61 and $\frac{97}{98}$ F. 41, where the right cellular mastoid is rounder than the diploëtic left. Even in sets which vary strikingly in their interior there is no striking external variation, as in $\frac{163}{164}$ F. 56, $\frac{193}{194}$ F. 61, $\frac{227}{228}$ F. 73, in all of which one bone is cellular and the other is diploëtic.

In connection with this, Iwanoff (Politzer's text-book, page 39) states that in brachycephalics the right mastoid process is poorly developed.

(*h*) *Thinning and perforation of the anterior surface of a cellular mastoid process*, close to the tympanic plate, is seen on the left side in $\frac{117}{118}$ M. 48. The condition is not due to disease in the mastoid cells, and would have passed without comment if precisely the same thing had not been seen in the left bone of a man, aged 45, not appearing in this series.

(*i*) *A large and unusually situated external opening for the petro-squamosal sinus* between the base of the zygoma and the post-glenoid tubercle is seen on the right side only in $\frac{17}{18}$ M. 9.

(*j*) The variations in the opening of the mastoid emissary vein will be considered when dealing with the posterior surface.

(ii) The Superior Surface

(*a*) *Grooving for the petro-squamosal sinus* is very well marked in three sets, although remains may be seen in others. There may be marked asymmetry.

$\frac{1}{2}$ M. $\frac{9}{12}$, the grooving is seen at the back part, that on the left side being more marked.

$\frac{13}{14}$ M. $3\frac{3}{12}$, the grooving is well marked on both sides, but is larger and deeper on the left. There is an external opening on both sides, the left being the larger, in the most usual position between the post-glenoid tubercle and the tympanic plate. On the right side the sinus passes under a bridge of bone before opening into the lateral sinus, while on the left side it is an open groove all the way.

$\frac{17}{15}$ M. 9, the grooving is large and deep all along the line of suture on the right side, the sinus passing under a bridge of bone behind to open into the lateral sinus groove; in front it perforates by a large opening between the base of the zygoma and the post-glenoid tubercle—a rare position. On the left side there is no grooving, the only existing sign being an external opening at the outer extremity of the Glaserian fissure.

$\frac{12}{12}\frac{1}{2}$ F. 48, the grooving is present on the left side only, there is no external opening.

(*b*) *Dipping down of the middle fossa*, altering the shape of the antrum by depressing its roof or causing the dura mater to intervene between the upper part of the cavity and the outer surface, occurs in nineteen sets. It is never symmetrical. It is present on both sides in six, but always more on one side than the other.

On both sides, but more marked on the right:

1. $\frac{167}{168}$ F. 57.
2. $\frac{193}{194}$ F. 61.
3. $\frac{209}{210}$ M. 66.
4. $\frac{227}{228}$ F. 73.

On both sides, but more on the left:

5. $\frac{199}{200}$ F. 63.
6. $\frac{203}{204}$ M. 64.

On the right side only in six:

1. $\frac{33}{34}$ F. 25.
2. $\frac{37}{38}$ M. 28.
3. $\frac{45}{46}$ M. 30.
4. $\frac{51}{52}$ F. 30.
5. $\frac{111}{112}$ M. 45.
6. $\frac{163}{164}$ F. 56.

On the left side only in seven:

1. $\frac{73}{74}$ M. 37.
2. $\frac{93}{94}$ M. 39.
3. $\frac{121}{122}$ F. 48. Depression behind the antrum.
4. $\frac{161}{162}$ M. 56.
5. $\frac{187}{188}$ M. 61.
6. $\frac{189}{190}$ F. 61.
7. $\frac{231}{232}$ F. 77.

It will be seen that it occurs about equally in the two sexes, nine being males and ten females.

It cannot be stated that the type of bone as regards presence or absence of cells has any influence in its production, for it is seen in all types. There is no external sign of its presence apart from cases of hydrocephalus which is not here represented.

The antrum may be high lying and yet the middle fossa may dip down, shutting part of the cavity out from the surface, as on the right side of $\frac{1}{1}\frac{1}{1}\frac{1}{2}$ M. 45.

(*c*) *A deep groove is present in the neighbourhood of the hiatus Fallopii* on the left side only in $\frac{9}{9}\frac{5}{6}$ M. 39, and on the right side only in $\frac{2}{2}\frac{3}{3}\frac{3}{4}$ F. 81; it is apparently for a vessel.

(iii) The Anterior Surface.

(*a*) *The openings for the petro-squamosal sinus* have already been alluded to.

(*b*) *The opening in the tympanic plate* is closed by bone on both sides at an early age in $\frac{9}{1}\frac{}{0}$ F. 2. On the other hand they are both unclosed by bone in $\frac{2}{2}\frac{5}{6}$ F. 21 and $\frac{5}{8}\frac{3}{4}$ F. 38. In $\frac{1}{1}\frac{3}{4}$ M. $3\frac{3}{1\,2}$ the opening is closed on the left side and not on the right.

(*c*) Sometimes, by no means always, above the age of sixty years *the tympanic plate undergoes marked thinning*, and a gap closed by membrane only appears in the atrophied bone, closely resembling the condition seen in early life. It is apparently due to movements of the jaw. It may be seen on both sides in—

$\frac{2}{2}\frac{2}{2}\frac{5}{6}$ F. 72.

$\frac{2}{2}\frac{3}{3}\frac{7}{8}$ F. 86.

On the right side in—

$\frac{2}{2}\frac{3}{3}\frac{5}{6}$ M. 82.

On the left side in—

$\frac{2}{2}\frac{0}{0}\frac{5}{6}$ F. 64.

(*d*) *Bony spicules crossing the floor at the bend of the internal carotid canal* are seen on the left side of $\frac{3}{3}\frac{1}{2}$ M. 24.

They are not present on the right side, but there is a small groove separated from the canal floor by a slight ridge.

(iv) The Posterior Surface.

(*a*) *The lateral sinus.*—As is well known, the right lateral sinus is usually larger and more forward than the left whatever the type of bone, owing to the opening of the longitudinal sinus being usually towards that side, and, as Politzer has pointed out, the sinus is more forward in diploëtic and slightly cellular bones, which points are borne out by this series. Iwanoff, previously referred to, states that in brachycephalic skulls the right temporal bone is not so well developed as the left and the right lateral sinus is far forwards and outwards. On this question I am not in a position to judge.

The left lateral sinus groove is, however, not infrequently, the larger, for there are twenty-six instances, a proportion much larger than one expected. It is more frequent in males than females.

1. $\frac{11}{12}$ $2\frac{2}{12}$.
2. $\frac{13}{14}$ M. $3\frac{3}{12}$.
3. $\frac{39}{40}$ F. 28.
4. $\frac{45}{46}$ M. 30.
5. $\frac{55}{56}$ M. 33.
6. $\frac{69}{70}$ F. 36.
7. $\frac{71}{72}$ F. 36.
8. $\frac{73}{74}$ M. 37.
9. $\frac{79}{80}$ M. 38.
10. $\frac{85}{86}$ F. 38.
11. $\frac{87}{88}$ M. 39.
12. $\frac{111}{112}$ M. 45.
13. $\frac{115}{116}$ M. 47.
14. $\frac{137}{138}$ F. 50.
15. $\frac{139}{140}$ M. 51.
16. $\frac{153}{154}$ F. 54.
17. $\frac{165}{166}$ M. 57.
18. $\frac{167}{168}$ F. 57.
19. $\frac{173}{174}$ M. 59.
20. $\frac{175}{176}$ M. 59.
21. $\frac{177}{178}$ M. 59.
22. $\frac{185}{186}$ M. 61.
23. $\frac{195}{196}$ F. 62.
24. $\frac{213}{214}$ M. 67.
25. $\frac{217}{218}$ M. 68.
26. $\frac{239}{240}$ F. 89.

Males . .	16
Females . .	9
Sex unknown .	1
Total . .	26

The greatest discrepancy in size of the grooves is seen in—

$\frac{111}{112}$ M. 45, where the left is three times the size of the right.

$\frac{147}{148}$ M. 53, where the left is very small.

$\frac{153}{154}$ F. 54, where the right is very small.

$\frac{185}{186}$ M. 61, where the left is very much larger than the right.

Equality in size and forwardness is seen in—

$\frac{41}{42}$ F. 28. Both grooves are large and both bones are mostly diploëtic.

$\frac{107}{108}$ M. 44. Both grooves are large and both bones diploëtic.

$\frac{145}{146}$ M. 52. Both grooves are large, the right bone being cellular and the left partly cellular and partly diploëtic.

The larger sinus is not always the more forward, for in the bilateral diploëtic and slightly cellular types both sinuses may be equally well forward, even though differing in size.

$\frac{101}{102}$ F. 37, where both sinuses are large and equally well forward, the right being somewhat the larger. Both bones are diploëtic.

$\frac{111}{112}$ M. 45, where the right sinus is one third the size of the left and yet both are equally forward. The right bone is almost

entirely diploëtic and the left is cellular except for the lower mastoid, which is diploëtic.

Extreme forwardness, the sinus reaching the posterior meatal wall, and being especially large in size, is seen in—

$\frac{109}{110}$ M. 45 on both sides, shutting out the apex of the antrum from the surface, both bones being diploëtic.

$\frac{151}{152}$ F. 54 on the right side, completely shutting out the antrum from the surface, the bone being diploëtic. The left bone is cellular.

$\frac{183}{184}$ M. 60 on the right side, shutting out the apex of a high lying antrum, the bone being diploëtic. The left bone is cellular.

Great forwardness in a cellular bone is seen in—

$\frac{91}{92}$ M. 39 on the right side, with a high lying antrum.

$\frac{235}{236}$ M. 82 on the right side.

The sinus is not always well forward in the diploëtic or slightly cellular types.

$\frac{37}{35}$ M. 28 where both bones are diploëtic and the right sinus is large and well forward and the left is not.

$\frac{43}{44}$ F. 29. Ditto.

$\frac{137}{139}$ F. 50 where both bones are diploëtic and the left sinus is large and well forward and the right is not.

$\frac{193}{194}$ F. 61, where the right bone is diploëtic and the left finely cellular throughout, neither sinus being well forward.

A deep pocket or sulcus in the left lateral sinus groove just before its exit is present in $\frac{115}{116}$ M. 47.

(*b*) *The mastoid emissary vein.*—This vein usually leaves the lateral sinus at a corresponding point on the two sides; although that point may vary immensely, it is, in the great majority of cases, below the knee of the vessel, for in one set only does it come off above the knee on both sides, the right vein being the large and the left rudimentary:

$\frac{9\,5}{9\,6}$ M. 39.

The internal opening in the bone is most frequently in the groove itself, or in its lower edge, but it may be some distance away, the vein running in an open groove before entering the bone, as on both sides of—

$\frac{1\,1\,9}{1\,2\,0}$ M. 48,

or on one side only, as in—

$\frac{1\,7\,5}{1\,7\,6}$ M. 59.

The point of emergence, which is subject to considerable variation in position, is usually symmetrical, but one may be further back than the other, as in—

$\frac{1\,3}{1\,4}$ M. $3\frac{3}{1\,2}$, where the left is in the occipital suture and the right farther forwards.

One side may be higher than the other, one running upwards and the other downwards, as in—

$\frac{1\,4\,7}{1\,4\,8}$ M. 53, where the right runs downwards and the left upwards.

A regular sulcus at the point of emergence is occasionally seen:

On the right side only in—

$\frac{1\,7}{1\,8}$ M. 9, with a diploic vein opening into it above, and,

$\frac{1\,2\,7}{1\,2\,8}$ M. 49.

On the left side only in—

$\frac{1\,9\,5}{1\,9\,6}$ F. 62.

On both sides in—

$\frac{57}{58}$ M. 33.

The size of the veins varies enormously; one side may be larger than the other, the larger being frequently associated with the larger lateral sinus, as in—

$\frac{77}{78}$ F. 37, where the right lateral sinus is the larger, the left mastoid vein being rudimentary,

but not always so, for the right lateral sinus may be the larger with the smaller mastoid vein, as in—

$\frac{35}{36}$ M. 28,

$\frac{161}{162}$ M. 56.

The vein may be indistinguishable on both sides, as in—

$\frac{115}{116}$ M. 47,

$\frac{239}{240}$ F. 89;

or it may be very small on both sides, as in—

$\frac{119}{120}$ M. 48,

or indistinguisable on one side and very small in the other, as in—

$\frac{153}{154}$ F. 54, the left being very small and the right indistinguishable.

It may be double at the start and exit on both sides, as in—

$\frac{229}{230}$ F. 76.

It may be double at the start and exit on one side and single at the start and exit on the other, as in—

$\frac{27}{28}$ F. 22, the right side being double.

It may be single at the start and double at the exit on both sides as in—

$\frac{57}{58}$ M. 33.

It may be single at the start and double at the exit on one side and single at the start and exit on the other, as in—

$\frac{71}{72}$ F. 36, where the left is double at the exit.

$\frac{73}{74}$ M. 37, where the left is double at the exit.

$\frac{105}{106}$ F. 43, where the right is double at the exit.

$\frac{235}{236}$ M. 82, where the right is double at the exit.

It may be double at the start and single at the exit on one side and single at both start and exit on the other, as in—

$\frac{193}{194}$ F. 61, where the right starts double and emerges single.

The knowledge of the possible variations is important in cases of thrombosis of the lateral sinus when the vein is likely to be implicated and require dealing with.

(v) The Inferior Surface.

(*a*) *The sulcus jugularis* is, broadly speaking, larger and higher lying on the side which has the larger lateral sinus namely the right, and this is especially well marked in—

$\frac{35}{36}$ M. 28.

$\frac{103}{104}$ M. 43.

$\frac{121}{122}$ F. 48.

$\frac{147}{148}$ M. 53.

$\frac{211}{212}$ F. 66.

In 32 sets, however, the left sulcus is larger than the right.

1. $\frac{7}{8}$ M. 2.
2. $\frac{11}{12}$ $2\frac{2}{12}$
3. $\frac{15}{16}$ F. 6.
4. $\frac{39}{40}$ F. 28.
5. $\frac{45}{46}$ M. 30.
6. $\frac{51}{52}$ F. 30.
7. $\frac{55}{56}$ M. 33.
8. $\frac{59}{60}$ F. 33.
9. $\frac{69}{70}$ F. 36.
10. $\frac{71}{72}$ F. 36.
11. $\frac{79}{80}$ M. 38.
12. $\frac{85}{86}$ F. 38.
13. $\frac{87}{88}$ M. 39.
14. $\frac{95}{96}$ M. 39.
15. $\frac{105}{106}$ F. 43.
16. $\frac{111}{112}$ M. 45.
17. $\frac{113}{114}$ M. 45.
18. $\frac{115}{116}$ M. 47.
19. $\frac{127}{128}$ M. 49.
20. $\frac{137}{138}$ F. 50.
21. $\frac{139}{140}$ M. 51.
22. $\frac{153}{154}$ F. 54.
23. $\frac{165}{166}$ M. 57.
24. $\frac{167}{168}$ F. 57.

25. $\frac{173}{174}$ M. 59.
26. $\frac{175}{176}$ M. 59.
27. $\frac{177}{178}$ M. 59.
28. $\frac{185}{186}$ M. 61.
29. $\frac{195}{196}$ F. 62.
30. $\frac{213}{214}$ M. 67.
31. $\frac{217}{218}$ M. 68.
32. $\frac{230}{240}$ F. 89.

Males . .	18
Females . .	13
Sex unknown .	1

It can be seen that this list includes all the sets in which the left lateral sinus is the larger, but leaves six over:

1. $\frac{1}{16}$ F. 6, where the right lateral sinus is somewhat the larger and the mastoid veins are equal.

2. $\frac{51}{52}$ F. 30, where the bones do not allow of comparison of the lateral sinuses and mastoid veins.

3. $\frac{95}{96}$ M. 39, where the left sulcus is somewhat the larger; both lateral sinuses are large, the right being slightly the larger, but the right mastoid vein coming off above the knee of the sinus is larger than the left, which is rudimentary.

4. $\frac{105}{106}$ F. 43, where the right mastoid vein and lateral sinus are the larger, but the left mastoid vein is rudimentary.

5. $\frac{113}{114}$ M. 45, in which set the bones do not allow of comparison of the lateral sinuses and mastoid veins.

6. $\frac{127}{128}$ M. 49, where both sulci are small, but the left is decidedly larger than the right. The right lateral sinus is the larger, but has a large mastoid vein, while the left mastoid vein is rudimentary.

Nos. 3, 4 and 6 of the above suggest that the size of the sulcus may sometimes depend on the size of the mastoid vein. Other sets also support this:

$\frac{35}{36}$ M. 28,

$\frac{109}{110}$ M. 45,

in both of which sets the right lateral sinus and sulcus are the larger, the left sulcus being out of all proportion smaller than the right, and the left mastoid vein being much larger.

$\frac{210}{220}$ M. 71, where both sulci are large and high lying and both mastoid veins are small.

But against such a suggestion are the following sets, which also show that a large lateral sinus does not always mean a large sulcus:

$\frac{183}{184}$ M. 60, where the right lateral sinus is large and the mastoid vein and sulcus are small, and—

$\frac{203}{204}$ M. 64, where both lateral sinuses are large and both sulci small, the right mastoid vein being rudimentary and the left small.

The position of the sulcus influences the spread of cells inwards, as in—

$\frac{53}{54}$ M. 35,

$\frac{103}{104}$ M. 43,

$\frac{139}{140}$ M. 51,

where the smaller sulcus allows of a larger spread of cells under the labyrinth.

High out-pushing sulci are seen in all types of bone.

(*b*) *Marked bulging of cells forming a bulla internally to, and behind, the mastoid process* (*digastric bulla*) is seen in thirteen sets:

1. $\frac{25}{26}$ F. 21 on both sides, more marked on the right.
2. $\frac{29}{30}$ M. 24 on the right side only.

3. $\frac{39}{40}$ F. 28 on both sides.
4. $\frac{103}{104}$ M. 43 on the right side only.
5. $\frac{131}{132}$ F. 49 on both sides.
6. $\frac{139}{140}$ M. 51 on both sides, more marked on the left.
7. $\frac{141}{142}$ M. 51 on both sides.
8. $\frac{145}{146}$ M. 52 on the right side only.
9. $\frac{195}{196}$ F. 62 on both sides, more marked on the left, where it runs up to the sulcus jugularis.
10. $\frac{207}{208}$ F. 64 on both sides, more marked on the left.
11. $\frac{209}{210}$ M. 66 on both sides.
12. $\frac{235}{236}$ M. 82 on the left side only.
13. $\frac{237}{238}$ F. 86 on both sides, more marked on the right.

In all these pus is liable to perforate into the neck internally to the mastoid process.

(*c*) *Specially large digastric fossæ* are seen in four sets:

1. $\frac{41}{42}$ F. 28, the left being the larger.
2. $\frac{49}{50}$ M. 30 on both sides.
3. $\frac{53}{54}$ M. 33 on the right side, the left not allowing of examination.
4. $\frac{59}{60}$ F. 33 on the right side, the left not allowing of examination.

2. The Interior.

(i) *Types.*

Classification of the types is founded on the conditions of the outer antral wall and mastoid process. In referring to the mastoid process the terms "upper and lower mastoid" are used, the "upper mastoid" being the bone below the level of the apex of the antrum down to the upper level of the projecting part or "lower mastoid."

This division is justified by the totally different surgical anatomical relationships.

On this basis it is found that of the 120 sets 82 are symmetrical and 38 asymmetrical. In many of the asymmetrical bones there is a tendency to symmetry.

It may be here stated that there are very few cellular bones without remains of diploë, either as a small mass at the extreme tip of the mastoid process, or as a rim round the tip.

Asymmetry as to extension of cells is indicated with each specimen.

Symmetrical.

(*a*) Dense outer antral wall lined internally with cells which can be seen at the eighth month of fœtal life, and therefore called fœtal cells, with a dense layer of bone between the antrum and a diploëtic mastoid. **Diploëtic infantile type** 24

For my description of this type and its surgical importance reference can be made to the 'Transactions of the Eighth International Congress of Otology' held in Buda-Pesth; in that paper, the importance of the type in conducing to intra-cranial complications in acute infection of the antrum and to chronic middle-

ear suppuration, and its sequelæ, apart from tuberculosis, was pointed out.

1. $\frac{1}{2}$ M. $\frac{9}{12}$.
2. $\frac{3}{4}$ F. $1\frac{7}{12}$.
3. $\frac{5}{6}$? $1\frac{9}{12}$
4. $\frac{7}{8}$ M. 2.
5. $\frac{11}{12}$? $2\frac{2}{12}$.
6. $\frac{13}{14}$ M. $4\frac{3}{12}$
7. $\frac{15}{16}$ F. 6.
8. $\frac{37}{38}$ M. 28.
9. $\frac{41}{42}$ F. 28.
10. $\frac{45}{46}$ M. 30.
11. $\frac{71}{72}$ F. 36.
12. $\frac{95}{96}$ M. 39.
13. $\frac{101}{102}$ F. 42.
14. $\frac{107}{108}$ M. 44.
15. $\frac{109}{110}$ M. 45
16. $\frac{137}{138}$ F. 50.
17. $\frac{149}{150}$ F. 53.
18. $\frac{153}{154}$ F. 54.
19. $\frac{155}{156}$ F. 55.
20. $\frac{169}{170}$ M. 58.
21. $\frac{181}{182}$ M. 60.
22. $\frac{213}{214}$ M. 67.
23. $\frac{217}{218}$ M. 68.
24. $\frac{231}{232}$ F. 77.

Males . .	12
Females . .	10
Sex unknown .	2
Children up to 6 years of age .	7
Adults . .	17

(*b*) Dense outer antral wall and very few cells in the upper mastoid. Diploëtic lower mastoid . . 1

1. $\frac{31}{32}$ M. 24.

(*c*) Dense outer antral wall. Cellular upper mastoid. Diploëtic lower mastoid 5

1. $\frac{23}{24}$ M. 20.
2. $\frac{27}{28}$ F. 22.
3. $\frac{49}{50}$ M. 30.
4. $\frac{161}{162}$ M. 56.
5. $\frac{201}{202}$ M. 64.

(*d*) Dense outer antral wall. Upper and lower mastoid cellular 1

$\frac{191}{192}$ F. 61. More diploë at the tip of the left mastoid than on the right.

(*e*) Diploëtic outer antral wall. A few cells in upper mastoid. Lower mastoid diploëtic . . . 1

$\frac{203}{204}$ M. 64.

(*f*) Cellular outer antral wall and upper mastoid. Lower mastoid diploëtic 12

1. $\frac{9}{10}$, F. 2.
2. $\frac{47}{48}$ M. 30.
3. $\frac{65}{66}$ F. 35.
4. $\frac{99}{100}$ M. 42.
5. $\frac{119}{120}$ M. 48.
6. $\frac{143}{144}$ M. 51
7. $\frac{147}{148}$ M. 53.
8. $\frac{165}{166}$ M. 57.
9. $\frac{171}{172}$ M. 58.
10. $\frac{183}{184}$ M. 60.
11. $\frac{221}{222}$ M. 72.
12. $\frac{223}{224}$ M. 72.

(*g*) Cellular outer antral wall and entire mastoid, some having more dipoë at the tip than the others, and some more one side than the other . . . 38

1. $\frac{21}{22}$ F. 16.
2. $\frac{25}{26}$ F. 21. Digastric bulla on both sides, more marked on the right.
3. $\frac{29}{30}$ M. 24. Digastric bulla on the right side only.
4. $\frac{33}{34}$ F. 25.
5. $\frac{39}{40}$ F. 28. Digastric bulla on both sides.
6. $\frac{51}{52}$ F. 30.
7. $\frac{61}{62}$ M. 34.
8. $\frac{63}{64}$ M. 35. The occipital diploë is invaded by cells on the right side and not on the left.
9. $\frac{67}{68}$ M. 36.
10. $\frac{69}{70}$ F. 36.
11. $\frac{79}{80}$ M. 38.
12. $\frac{81}{82}$ M. 38. Extension inwards, behind the

middle ear under the labyrinth and invading the lower part of the internal diploë on both sides.

13. $\frac{83}{84}$ F. 38.

14. $\frac{85}{86}$ F. 38.

15. $\frac{89}{90}$ M. 39. The cells on the left side only extend inwards behind the middle ear and under the labyrinth.

16. $\frac{91}{92}$ M. 39.

17. $\frac{103}{104}$ M. 43. The cells extending inwards under the labyrinth are larger on the left side where the sulcus jugularis is not so high.

Digastric bulla on the right side only.

18. $\frac{117}{118}$ M. 48.

19. $\frac{123}{124}$ F. 48. Mastoid cortex dense and thick on the right side and thin on the left.

20. $\frac{131}{132}$ F. 49. Digastric bulla on both sides.

21. $\frac{133}{134}$ M. 50.

22. $\frac{135}{136}$ F. 50.

23. $\frac{139}{140}$ M. 51. The cells extend over the meatus into the zygoma on both sides. Extension inwards behind the middle ear under the labyrinth and invading the lower part of the internal diploë on both sides, but more on the right, on which side the sulcus jugularis is not so high.

Digastric bulla on both sides, more marked on the left.

24. $\frac{141}{142}$ M. 51. Digastric bulla on both sides, more marked on the right.

25. $\frac{159}{160}$ F. 55.
26. $\frac{167}{168}$ F. 57.
27. $\frac{179}{180}$ M. 59.
28. $\frac{185}{186}$ M. 61.
29. $\frac{189}{190}$ F. 61.
30. $\frac{195}{196}$ F. 62. Digastric bulla on both sides, more marked on the left, where it runs inwards to the sulcus jugularis.
31. $\frac{197}{198}$ F. 62.
32. $\frac{207}{208}$ F. 64. Digastric bulla on both sides, more marked on the left.
33. $\frac{209}{210}$ M. 66. Digastric bulla on both sides.
34. $\frac{211}{212}$ F. 66. Cells extending up into the squama on the right side only.
35. $\frac{219}{220}$ M. 71.
36. $\frac{225}{226}$ F. 72.
37. $\frac{235}{236}$ M. 82. Digastric bulla on the left side only.
38. $\frac{237}{238}$ F. 86. Digastric bulla on both sides, more marked on the right.

Males . .	18
Females . .	20
Total .	38

Total symmetrical . 82

Asymmetrical.

In many of the asymmetrical sets it will be seen that there is a decided tendency to symmetry.

(*a*) Diploëtic infantile type on one side (*a*).

Fine cells in the outer antral wall and diploëtic mastoid on the other; a rare condition (*b*) . . 2

1. $\frac{(a)}{(b)}\ \frac{4\,3}{4\,4}$ F. 29.

2. $\frac{(a)}{(b)}\ \frac{1\,0\,0}{2\,0\,0}$ F. 63.

In these sets suppuration is likely to perforate the outer antral wall on the left side.

(*b*) Diploëtic infantile type on one side (*a*). Dense outer antral wall with a few cells in the upper part of a diploëtic mastoid on the other (*b*) . . 5

1. $\frac{(b)}{(a)}\ \frac{1\,0}{2\,0}$ M. 11.

2. $\frac{(b)}{(a)}\ \frac{5\,7}{5\,8}$ M. 33.

3. $\frac{(a)}{(b)}\ \frac{7\,7}{7\,8}$ F. 37.

4. $\frac{(a)}{(b)}\ \frac{1\,2\,7}{1\,2\,8}$ M. 49.

5. $\frac{(b)}{(a)}\ \frac{1\,8\,7}{1\,8\,8}$ M. 61.

(*c*) Diploëtic infantile type, on one side (*a*). Dense outer antral wall, cellular upper mastoid and diploëtic lower mastoid, on the other (*b*) . . . 3

1. $\frac{(a)}{(b)}\ \frac{3\,5}{3\,6}$ M. 28.

2. $\frac{(b)}{(a)}\ \frac{1\,1\,5}{1\,1\,6}$ M. 47.

3. $\frac{(a)}{(b)}\ \frac{1\,2\,1}{1\,2\,2}$ F. 48.

(*d*) Diploëtic infantile type, on one side (*a*). Cellular outer antral wall and upper mastoid and diploëtic lower mastoid, on the other (*b*) . . . 5

1. $\frac{(a)}{(b)}\ \frac{0\,3}{0\,4}$ M. 39.

2. $\frac{(b)}{(a)}\ \frac{1\,c\,0}{1\,3\,0}$ M. 49.

3. $\frac{(a)}{(b)}\ \frac{1\,5\,1}{1\,5\,2}$ F. 54.

4. $\frac{(b)}{(a)}\ \frac{1\,7\,3}{1\,7\,4}$ M. 59.

5. $\frac{(a)}{(b)}\ \frac{2\,3\,3}{2\,3\,4}$ F. 81.

(*e*) Diploëtic infantile type, on one side (*a*). Cellular outer antral wall and entire mastoid, on the other (*b*) 5

1. $\frac{(a)}{(b)}\ \frac{9\ 7}{9\ 8}$ F. 41.
2. $\frac{(b)}{(a)}\ \frac{1\ 0\ 5}{1\ 0\ 6}$ F. 43. The cells in the right are small and surrounded by dense bone; diploë at the tip of the mastoid.
3. $\frac{(b)}{(a)}\ \frac{1\ 6\ 3}{1\ 6\ 4}$ F. 56.
4. $\frac{(a)}{(b)}\ \frac{1\ 9\ 3}{1\ 9\ 4}$ F. 61.
5. $\frac{(a)}{(b)}\ \frac{2\ 2\ 7}{2\ 2\ 8}$ F. 73. Densely diploëtic on the right.

(*c*), (*d*), and (*e*) explain why, in acute bilateral antral infection, a mastoid abscess may result on one side and a chronic discharge without a mastoid abscess on the other.

Those specimens which have only a dense outer wall and a very few cells in the upper part of a diploëtic mastoid have the same surgical importance with regard to the suppuration as the pure diploëtic type, and the same applies to those bones in which the entire mastoid is composed of cells surrounded by a thick layer of dense bone.

There are, therefore, twenty sets in which the diploëtic infantile type is seen on one side only. On the right side in twelve, and on the left side in eight.

Nine are in males and eleven in females.

It is interesting to note that in the whole series of a hundred and twenty individuals the type is seen in forty-four; on both sides in twenty-four, and on one side in twenty.

(*f*) Dense outer antral wall, cellular upper mastoid, and diploëtic lower mastoid, on one side (*a*).

Dense outer antral wall and entirely cellular mastoid, on the other (*b*) 3

1. $\frac{(a)\ 1\ 1\ 3}{(b)\ 1\ 1\ 4}$ M. 45.
2. $\frac{(a)\ 2\ 0\ 5}{(b)\ 2\ 0\ 6}$ F. 64.
3. $\frac{(a)\ 2\ 3\ 9}{(b)\ 2\ 4\ 0}$ F. 89.

(*g*) Dense outer antral wall, cellular upper mastoid and diploëtic lower mastoid, on one side (*a*).

Cellular outer antral wall and upper mastoid and diploëtic lower mastoid, on the other (*b*) . . . 3

1. $\frac{(a)\ 7\ 3}{(b)\ 7\ 4}$ M. 37. Very few cells in the upper mastoid on the right side.
2. $\frac{(a)\ 1\ 1\ 1}{(b)\ 1\ 1\ 2}$ M. 45. Very few cells in the upper mastoid on the right side.
3. $\frac{(b)\ 1\ 5\ 7}{(a)\ 1\ 5\ 8}$ F. 55.

(*h*) Dense outer antral wall, cellular upper mastoid and diploëtic lower mastoid, on one side (*a*).

Cellular outer antral wall and entire mastoid on the other (*b*) 2

1. $\frac{(a)\ 1\ 2\ 5}{(b)\ 1\ 2\ 6}$ M. 49.
2. $\frac{(a)\ 1\ 7\ 5}{(b)\ 1\ 7\ 6}$ M. 59.

(*i*) Dense outer antral wall and entire mastoid cellular, on one side (*a*).

Cellular outer antral wall and entire mastoid, on the other (*b*) 1

1. $\frac{(b)\ 8\ 7}{(a)\ 8\ 8}$ M. 39.

(*j*) Cellular outer antral wall and upper mastoid, lower mastoid diploëtic, on one side (*a*).

Cellular outer antral wall and entire mastoid, on other (*b*) 6

1. $\frac{(a)\ 1\ 7}{(b)\ 1\ 8}$ M. 9.
2. $\frac{(b)\ 5\ 3}{(a)\ 5\ 4}$ M. 33.
3. $\frac{(b)\ 1\ 4\ 5}{(a)\ 1\ 4\ 6}$ M. 52. On the right side, the cells extend inwards from the mastoid, forming a digastric bulla.

4. $\frac{(b)}{(a)}\ \frac{177}{178}$ M. 59.
5. $\frac{(b)}{(a)}\ \frac{215}{216}$ M. 68.
6. $\frac{(b)}{(a)}\ \frac{229}{230}$ F. 76.

These sets show that in double mastoid infection the lower mastoid is not necessarily affected on both sides.

Diploë in the outer antral wall is very unusual; it is present on one side only in the three following sets. Reference has already been made to $\frac{203}{204}$ M. 64, where diploë is present in the outer antral wall on both sides.

(*k*) Diploëtic outer antral wall and entire mastoid, on side (*a*).

Dense outer antral wall with a few cells just below the apex of the antrum, the remainder of the mastoid being diploëtic, on the other (*b*) 2

1. $\frac{(b)}{(a)}\ \frac{55}{56}$ M. 33.

The left bone in this set is a rare and interesting one.

The section shows the diploë in the zygomatic squamous and petrous elements, separated from one another by distinct partitions of compact bone, and the squamous diploë forming the outer antral wall, which is half an inch in thickness, is separated from the cells which always line the outer antral wall (fœtal cells) by another thin layer of compact bone. On the right side the dense outer antral wall is formed by thickening of the compact bony partition between the zygomatic and squamous masses of diploë.

This type of bone is responsible for those cases of infection from the antrum which run an osteomyelitic course.

2. $\frac{(a)}{(b)}\ \frac{59}{60}$ F. 33.

The right bone of this set is very like the left one

of the previous set, but the layer of diploë in the outer antral wall is much thinner and the compact layer between the diploë and the fœtal cells is much thicker.

(*l*) *3.* Diploëtic outer antral wall, cellular upper mastoid and diploëtic lower mastoid, on one side (*a*)

Dense outer antral wall with cells in the base of the upper mastoid, the remainder of which is diploëtic, on the other (*b*) 1

1. $\frac{(b)}{(a)}\ \frac{7\ 5}{7\ 6}$ M. 37.

The left bone shows a thin outer layer of diploë formed by the zygomatic squamous and mastoid elements with distinct thin separating layers of compact bone. The zygomatic element forms the outer antral wall, the antrum being high lying.

Total asymmetrical . 38

(ii) *The size and shape of the antrum* are subject to very slight variation on the two sides; a difference, and that a small one, is only seen in two sets—

1. $\frac{1\ 0\ 7}{1\ 0\ 8}$ M. 44,

2. $\frac{1\ 4\ 9}{1\ 5\ 0}$ F. 53,

in both of which sets the left antrum is smaller than the right, both bones being of the diploëtic infantile type.

(iii) *High lying antrum* in relation to the posterior zygomatic line is seen in nineteen sets:

1. $\frac{3\ 7}{3\ 8}$ M. 28. Bilateral diploëtic infantile type.

2. $\frac{3\ 9}{4\ 0}$ F. 28. Higher on the right side.

3. $\frac{5\ 3}{5\ 4}$ M. 33.

4. $\frac{6\ 1}{6\ 2}$ M. 34.

5. $\frac{7\ 3}{7\ 4}$ M. 37. Higher on the right side, where the bone is nearly of the pure diploëtic infantile type, for there is only one small cell in the mastoid diploë.

6. $\frac{75}{76}$ M. 37.
7. $\frac{87}{88}$ M. 39.
8. $\frac{91}{92}$ M. 39.
9. $\frac{103}{104}$ M. 43.
10. $\frac{111}{112}$ M. 45.
11. $\frac{139}{140}$ M. 51.
12. $\frac{147}{148}$ M. 53. On the right side only.
13. $\frac{177}{178}$ M. 59. Higher on the right side.
14. $\frac{183}{184}$ M. 60.
15. $\frac{185}{186}$ M. 61. On the right side only.
16. $\frac{195}{196}$ F. 62. Higher on the right side.
17. $\frac{213}{214}$ M. 67. Bilateral diploëtic infantile type.
18. $\frac{221}{222}$ M. 72.
19. $\frac{223}{224}$ M. 72.

It is in the great majority of cases symmetrical, for in two sets only is the antrum high lying on one side and not on the other:

$\frac{147}{148}$ M. 53,
$\frac{186}{186}$ M. 61,

where the right in each instance is the high lying one.

In four sets one antrum is higher than the other, and the higher one is, in all, on the right side:

1. $\frac{39}{40}$ F. 28.
2. $\frac{73}{74}$ M. 37.
3. $\frac{177}{178}$ M. 59.
4. $\frac{195}{196}$ F. 62.

It is more common in males than in females, for seventeen are males and only two are females.

It is most commonly seen in the cellular bones, for in two sets only is it present in the diploëtic infantile type, and in them on both sides

1. $\frac{37}{38}$ M. 28.

2. $\frac{2}{2}\frac{1}{1}\frac{3}{4}$ M. 67.

The antrum may be high lying and yet the middle fossa may dip down, partly shutting off the cavity from the surface as, on the right side, in

$\frac{1}{1}\frac{1}{1}\frac{1}{2}$ M. 45.

There is no reliable external guide to a high lying antrum, except that a posterior zygomatic line which slopes downwards and backwards should put one on one's guard.

(iv) *The sinus tympani* or internal pyramidal recess cannot be examined in all specimens, but the sets,

$\frac{1}{1}\frac{7}{7}\frac{1}{3}$ M. 58,

$\frac{2}{2}\frac{0}{0}\frac{3}{4}$ M. 64,

deserve careful study, for an extraordinarily large cavity is seen on both sides in each. This cavity may be infected in suppuration and responsible for chronic discharge with or without antral infection and for the continuation of discharge after a radical operation has been performed. Unless the cavities are as large as these, it is practically impossible to deal with them without injury to the facial nerve; but if they are large they can be opened immediately below the external semi-circular canal and behind the level of the descending part of the facial nerve, cleaned of contents and laid well open into the bony wound, as in a case of a boy, aged 9 years, described by myself in the 'Transactions of the Royal Society of Medicine, Otological Section,' vol. iv, No. 4, p. 54.

It is interesting to note that Mr. G. J. Jenkins considers this cavity as the upper end of the first branchial cleft.

The diagnosis of disease in this cavity cannot be dealt with in this paper.

(v) *Malformation of the bony external semi-circular canal* is seen in *191*, the right bone of a woman, aged 61 years. The canal is represented by a single large cavity opening

widely into the outer wall of the vestibule. A small tubercle on the upper part of the sloping posterior wall of the cavity represents the only attempt at the formation of the normal partition.

The canals on the left side are normal.

B. IN DISEASE.

(i) *Injuries.*

Fracture through the bone is seen in three sets only.

1. *23.* The right bone of a male, aged 20 years. The fracture passes through the middle ear and posterior part of the labyrinth dividing the facial nerve.
2. *180.* The left bone of a male, aged 59 years. The fracture passes through the middle ear, meatus, and mastoid cells just externally to the external semi-circular canal. The facial nerve is not divided.
3. *184.* The left bone of a male, age 60 years. The fracture passes right across the bone just externally to the external semi-circular canal, dividing the facial nerve in its descending course.

(ii) *Changes in bone.*

(*a*) *Exostoses in the meatus* on both sides more marked on the right in—

$\frac{165}{166}$ M. 57.

(*b*) *A sessile exostosis* is present on the inner wall of a large cell *in the lower mastoid* of the right bone of—

179 M. 599.

(*c*) *Hyperostosis of the tympanic plate* on both sides, in—

$\frac{215}{216}$ M. 68.

(*d*) *Thinning of the tympanic plate*, due to the presence of masses of epithelium, keratosis obturans, in seen on both sides of—

$\frac{8\,5}{8\,6}$ F. 38,

being more marked on the left. Evidence of past suppuration is seen in both membranes.

(*e*) *Bony excrescences on the inner aspect of the bone* are seen in five sets, all associated with mental trouble:

1. $\frac{4\,9}{5\,0}$ F. 30. A general paralytic. An exostosis is seen on the lower edge of the lateral sinus groove on the right side only.
2. $\frac{6\,5}{6\,6}$ F. 35. An epileptic dement. The excrescences are present on the inner surface of the squama on both sides, but more marked on the left. There is also great thickening of the parietal bone.
3. $\frac{7\,5}{7\,6}$ M. 37. An epileptic dement. An exostosis is present on the lower edge of the lateral sinus groove, on the left side only. The markings of the cerebral convolutions are very pronounced on both sides.
4. $\frac{1\,3\,1}{1\,3\,2}$ F. 49. A melancholic. The excrescences are seen on the inner aspect of the squama, on the left side especially.
5. $\frac{2\,3\,7}{2\,3\,8}$ F. 86. A senile dement. The same as the preceding specimen.

(*f*) *Great thickening of the skull with corrugations and deep groovings* due to osteitis deformans, is seen on both sides in—

1. $\frac{2\,2\,9}{2\,3\,0}$ F. 76.

The thickening is seen in the parietal bones, the temporal bone escaping altogether, but the inner aspect of the squama is corrugated and deeply grooved for vessels.

(*g*) *Extreme dilatation, with thinning of the left internal auditory meatus*, due to the presence of a cerebellar tumour, is seen in *52*, the left bone of a female, aged 30.

(*h*) *Fixation of the stapes* is seen in—

$\frac{7}{7}\frac{1}{2}$ F. 36.

This patient had been getting deaf since childhood. For many years, about eight, she had been insane with subacute mania. Death was due to pulmonary and intestinal tuberculosis. She had very marked hallucinations of hearing, hearing voices and chattering to imaginary persons. She also gave a rambling and confused account of a medical student whom she loved and who had promised to marry her after he had operated on her for deafness. She spoke in a slow wailing monotone.

Her father had been deaf since boyhood and at one time heard better in a noise.

Both bones are of the diploëtic infantile type, and both membranes are intact.

Right bone.—Outer vestibular wall.

(*i*) From the vestibular side. The posterior half of the base of the stapes appears thickened and pushed well through the oval window and fixed, while the anterior is not thickened and appears a little tilted out from the window as if the stapedius muscle had exerted a permanent effect. The anterior half of the upper lip of the oval window is much thickened.

(*ii*) From the tympanic side. The inner half of the crura of the stapes are buried in new tissue, the bone being absolutely fixed.

Left bone.—Outer vestibular wall.

(*i*) From the vestibular side. Very similar to the right side.

(*ii*) From the tympanic side. The crura of the stapes (fractured accidentally) are not so buried as on the right side, but the base is firmly fixed.

It is interesting to note that both bones are of the diploëtic infantile type.

(iii) *Evidence of suppuration is seen in thirteen sets.* The type of bone on both sides in each set is described.

(*a*) Evidence in the membrane without sign of antral infection.

1. $\frac{7}{7}\frac{5}{6}$ M. 37. *Right bone.*—Calcareous deposit in the anterior and posterior segments. No sign of antral infection. Dense outer antral wall with a few cells in the upper part of a diploëtic mastoid.

Left bone.—Crescentic calcareous deposit, with a dry perforation in the anterior inferior segment.

Ossicles intact. No sign of antral infection. Diploëtic and cellular outer antral wall, cellular upper mastoid, diploëtic lower mastoid.

In the writer's opinion calcareous deposits are always the result of a pyogenic infection.

2. $\frac{8}{8}\frac{5}{6}$ F. 38. *Right bone.*—Cicatrix in the posterior segment.

Tympanic plate thinned by the presence in the meatus of layers of epithelium (keratosis obturans). No sign of antral infection.

Cellular outer antral wall and mastoid, the tip of which is diploëtic.

Left bone.—Dry perforation in the posterior superior segment.

Ossicles intact. Meatus markedly dilated, the tympanic plate being very much thinned by keratosis obturans. No sign of antral infection.

Cellular outer antral wall and entire mastoid.

These two sets point to the fact that the antrum does not always share in infection of the lower middle ear, for if the cavity was ever infected in them, it is difficult to understand why an acute mastoid abscess did not result. The cavity is more likely to be primarily implicated in virulent infection due to scarlet fever, measles, and influenza. In specimens like these, however, a fresh or the old infection may at any time spread to the antrum and mastoid cells, producing acute mastoid signs and symptoms.

3. $\frac{181}{182}$ M. 60.—*Right bone.*—Membrane was intact, but injured on section. No sign of infection.

Diploëtic infantile type.

Left bone.—Large dry inferior kidney-shaped perforation. Ossicles intact. No sign of antral infection.

Diploëtic infantile type.

In this left bone it would have been impossible for a mastoid abscess to form if the antrum had been also infected.

(*b*) Evidence in the membrane only on one side and in the antrum as well on the other.

1. $\frac{87}{88}$ F. 41. *Right bone.*—Dry perforation in the in-

ferior segment. Ossicles intact. No sign of antral infection.

Dense outer antral wall, entire mastoid cellular.

Left bone.—Anterior and posterior segments cicatricial.

No perforation. Ossicles intact. The antral walls are smoothed out as if the cavity had at one time been infected. No cholesteatoma. Diploëtic infantile type.

In this right bone, infection of the antrum must have led to mastoid disease, thus again pointing to the fact that the antrum does not always share in infection with the lower middle ear. In the left, the signs of infection of the antrum seem to be clear and yet healing had occurred, and if mastoid cells had been present mastoid disease would have certainly resulted.

2. $\frac{1}{1}\frac{1}{2}\frac{9}{0}$ M. 48. *Right bone.*—Dry inferior perforation. Ossicles intact. No sign of antral infection.

Cellular outer antral wall and mastoid, the tip of which is diploëtic.

Left bone.—Posterior inferior perforation. Ossicles intact.

The lining membrane of the antrum and mastoid cells appears thickened.

Cellular outer antral wall and mastoid, the cells being surrounded by dense bone.

In this right bone again if the antrum had shared in the infection of the lower middle ear mastoid disease must have resulted.

In the cellular left bone, chronic discharge had been present, but, as previously stated, a bone with mastoid cells surrounded by dense bone is as conducive to a chronic middle-ear discharge as is the pure diploëtic infantile type.

(*c*) Evidence in the middle ear and antrum on both sides.

1. $\frac{0\,5}{9\,6}$ M. 39. *Right bone.*—Pus in the middle ear. Perforation in Shrapnell's membrane. Loss of the incus and head of the malleus. Erosion of the outer attic wall. Stapes intact.

Cholesteatoma in the attic and filling the antrum. Smoothing out of the antral walls.

Diploëtic infantile type.

Left bone.—Pathological conditions exactly similar to those on the right side, except that there are calcareous deposits in the anterior and inferior segments of the membrane.

Diploëtic infantile type.

This set demonstrates how symmetry of anatomical type produces symmetrical pathological conditions.

(*d*) Evidence in the middle ear and antrum on one side, the other side being normal.

1. $\frac{3\,1}{3\,2}$ M. 24. *Right bone.*—Normal. Membrane intact. Dense outer antral wall; a few cells are present in the upper part of a diploëtic mastoid.

Left bone.—The radical operation has been performed and the middle fossa opened.

Death occurred from cerebellar abscess; the pathway of infection is unknown.

Diploëtic infantile type.

This left bone illustrates the fact that the diploëtic or infantile type is conducive not only to chronic suppuration, but to its more dangerous sequelæ.

2. $\frac{101}{102}$ F. 42. *Right bone.*—Normal. Membrane intact.

Diploëtic infantile type.

Left bone.—Perforation in the posterior segment. Ossicles intact. No discharge. The inner and posterior antral walls are smoothed out.

Diploëtic infantile type.

It is interesting to note that healing had taken place without operation on the antrum.

3. $\frac{115}{116}$ M. 47. *Right bone.*—Normal. Membrane intact.

Dense outer antral wall; cellular mastoid with a diploëtic tip.

Left bone.—Large loss of the membrana tensa. Loss of the articular process of the incus. Thickening of the antral lining membrane.

Diploëtic infantile type.

4. $\frac{137}{138}$ F. 50. *Right bone.*—Normal. Membrane intact.

Diploëtic infantile type.

Left bone.—Pus was present in the middle ear and antrum, which is small. Large loss of the membrana tensa.

Ossicles intact.

Diploëtic infantile type.

In this left bone, if simple treatment did not produce a cure, the trouble would probably have been amenable to an incomplete mastoid operation.

5. $\frac{1}{1}\frac{5}{5}\frac{3}{4}$ F. 54. *Right bone.* Normal. Membrane was intact, but has split.

Diploëtic infantile type.

Left bone. Pus in the middle ear and antrum. Perforation in Shrapnell's membrane and posterior segment. Loss of the head of the malleus, incus, and crura of the stapes. Erosion of the outer attic wall. Niche for the oval window filled by new tissue. All the walls of the antrum are smoothed out, the fœtal cells being completely destroyed.

There was no cholesteatoma.

Diploëtic infantile type.

6. $\frac{1}{1}\frac{2}{2}\frac{7}{3}$ M. 49. *Right bone.*—Pus in the middle ear and antrum.

Complete loss of the membrane, malleus, incus and crura of the stapes, the base of which is intact, as can be seen from the vestibular side. The oval window niche is filled with new tissue. Marked erosion of the outer attic and posterior superior deep meatal walls; the inner and posterior antral walls are smoothed out. The mass of fœtal cells has been converted into a mass of dense bone, narrowing the aditus and antral cavity; this loca-

lised osteo-sclerotic condition can be easily distinguished from the normally dense outer antral wall.

There was no cholesteatoma.

Diploëtic infantile type.

Left bone.—Normal. Membrane intact. The outer antral wall is thick and dense and the mastoid diploëtic, with the exception of a few small cells running downwards from the apex of the antrum.

7. $\frac{2}{2}\frac{3}{3}\frac{1}{2}$ F. 77. *Right bone.*—Pus in the middle ear and antrum.

Perforation was present in Shrapnell's membrane, but details were destroyed accidentally on section. Erosion of the outer attic wall. The aditus is much narrowed by thickening of the free border of the squama of the petro-squamosal junction. The antral walls are smoothed out, the fœtal cells being completely destroyed up to the normal dense outer wall. The roof of the antrum is much thickened by osteo-sclerosis. There was no cholesteatoma.

Diploëtic infantile type.

Left bone.—Normal; membrane intact.

Diploëtic infantile type.

This is the oldest specimen of chronic middle-ear suppuration which I possess. The woman died of senile mania, broncho-pneumonia, and heart failure.

(*e*) The two last sets have been placed together, for the

affected bones show that a certain amount of osteo-sclerosis may take place in the walls of the antrum as a result of chronic suppuration, but it can always be distinguished from the normal dense outer antral wall, so characteristic of the normal diploëtic infantile type.

All the bones affected with chronic suppuration with antral implication are of the diploëtic infantile type, with the exception of *120* already described in which there are small mastoid cells surrounded by dense bone, a condition having the same surgical significance as the pure diploëtic infantile type, and, as may be seen in $\frac{1}{1}\frac{0}{0}\frac{1}{2}$ F. 42, $\frac{1}{1}\frac{3}{3}\frac{7}{8}$ F. 50, $\frac{1}{1}\frac{5}{5}\frac{3}{4}$ F. 54, $\frac{2}{2}\frac{3}{3}\frac{1}{2}$ F. 77, suppuration was present in the middle-ear tract, including the antrum, on one side only, the other side being normal, and yet the diploëtic infantile type is present on *both* sides, thus adding emphasis to the fact that the conditions present in that type, viz. a dense outer antral wall, lined internally by the fœtal cells and a dense layer of bone separating the antrum from the diploëtic mastoid process, are factors in producing chronic middle-ear discharge, and the density is not a result.

To those who hold that the dense outer antral wall is the result of chronic suppuration, it can be pointed that the condition is present in this series without any signs of suppuration, on both sides in 18, and on one side in 16.

It can be confidently expected that in the future X-ray photography will be of the greatest value in the diagnosis and treatment of suppurative disease.

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